**Mutations**

*A change in the sequence of nucleotides in an organism's genetic material is known as a****mutation****.*

**Background**

Mutations can occur randomly during DNA replication when base pairs are added, deleted, or substituted, or they can be caused by environmental factors, such as overexposure to radiation or toxic chemicals.

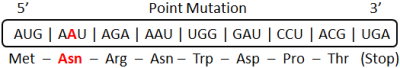
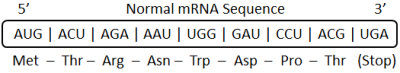
Mutations can occur in any cell in an organism's body, but they will be passed on to an organism's offspring only if the mutation occurs in the sex cells (gametes) of the organism. If a mutation occurs in the body cells of an organism, such as skin cells, bone cells, muscle cells, and nerve cells, it cannot be passed on to potential offspring. These mutations can only be passed on to the mutant body cells' daughter cells (cells that are produced when the mutant cell divides).

Sometimes mutations create changes in an organism's appearance or behavior. Some of these changes may be beneficial; other changes may be detrimental. And sometimes mutations have no effect on an organism at all.

**Point Mutations**

A **point mutation** is a mutation in a single base pair in a strand of DNA. Some genetic diseases, like cystic fibrosis, color blindness, hemophilia, and sickle cell anemia, can occur as a result of a point mutation.

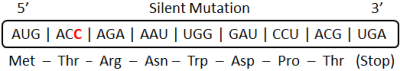
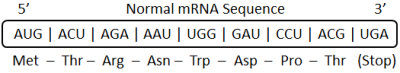
The image below demonstrates an example of a point mutation. Notice how the substitution of a single base pair results in a different amino acid. The remainder of the protein sequence remains unchanged.



**Silent Mutation**

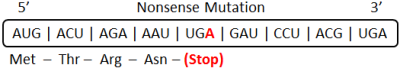
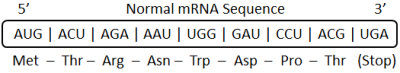
A **silent mutation** is a specific type of point mutation. Because many amino acids have more than one codon, it is possible for a mutation in a single base pair to have no effect on the polypeptide sequence.

The example below shows how some mutations are silent, meaning they have no effect on the translated protein. Though the second codon, or triplet code, has changed, the amino acid sequence of the resulting protein is the same as that coded for by the normal mRNA strand.



**Nonsense Mutation**

A **nonsense mutation** changes an amino acid codon into a stop codon. This causes the normal polypeptide sequence to be shorter.



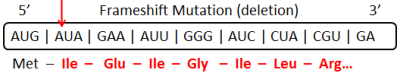
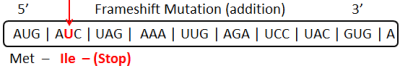
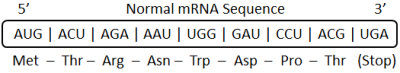
The image above shows how proteins are truncated by nonsense mutations.

**Frameshift Mutations**

A **frameshift mutation** is a mutation that causes the reading frame of a codon sequence to be shifted.

Since a codon is a sequence of three nucleotides that code for a specific amino acid, any insertion or deletion of nucleotide base pairs that are not in multiples of three will cause a frame shift mutation. Insertions or deletions in multiples of three will cause a protein to be shorter or longer than normal, but the entire sequence of the amino acids will not be shifted.

The image below shows how insertions and deletions affect the polypeptide sequence.



**Chromosome Translocation**

Chromosome translocation is caused when material is exchanged between two chromosomes or part of one chromosome becomes fused onto another chromosome. Some human disorders, such as cancer, infertility, and translocation Down syndrome, are caused by chromosome translocation.